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will study the geography and history of China, Japan, and Korea, and they will naturally dwell upon the late trouble in China. Some of the stories and episodes that have been told by those who were in Pekin or in other places in China at that time will be related, and the one seeming most capable of dramatization will be resolved into a play. This will necessitate a close study of Chinese character and temperament, also a study of their social life and conditions, manners, customs, and costumes. The material for this study we have in the school. For references, see Miss Baber's outline. In this connection the class will read orally the address on Chinese jurisprudence by Wu Ting Fang, Chinese ambassador to the United States, also *The Chinese View of the Christian Easter* by the same author.

For the month's work in spoken English, see the December COURSE OF STUDY.

Mathematics

George W. Myers

Pedagogic School

Teachers who gather their ideas from the text-books as to methods of presenting subjects to pupils are apt to be led astray in many ways. One of the most common of these ways originates in the assumption that because the books usually introduce the subject with a formidable list of definitions of technical terms, the ability to give correct definitions is the *first* result to be sought. It would be difficult to commit a more egregious pedagogic error than putting this into practice. It is trite to say that the definition of a term, even though it may be made *verbally* intelligible, can have no vital significance to a mind devoid of the idea being defined, as used in the unknown subject. The necessity for and meaning of the implications and limitations of the definition can be appreciated only by the master of the subject. Consequently it should be borne in mind by the teacher that the ability to define terms intelligibly marks the *final*, not the *initial*, stages of study of an inductive, if not of a deductive, science. There is then less unreason in testing the degree of a pupil's mastery of a subject by a set of examination questions calling for definitions than in the teacher's calling for the definitions at the outset, though neither practice is advocated.

If, however, it be granted that an inadequate or incomplete definition must sometimes be taught, either because of the immaturity or faulty early preparation of the pupil, the partial definition must not be taught in such a way as to hamper the student later when he meets the necessity of learning the complete definition. For example, to teach the pupil that "multiplication is using one number as an addend as many times as there are units in another," or "is taking one number as many times as there are units in another," and that therefore it is not possible to multiply a number by ¾, because "you cannot take a number ¾ of a time," is pedagogical treason. The partial truth must not be taught as the whole truth and then so thoroughly drilled into the pupil that he cannot make the necessary extension of the definition when the time comes. The name of the pedagogical sins which may be enrolled under this category is legion, and mathematics is the chief sufferer from them.

Educators who have given the subject

most thought seem pretty well agreed that the earlier stages of number study and arithmetic should be inductive. If there is any one thing that the inductive sciences have taught us more clearly than another, it is the primary importance of clear and accurate ideas, and the secondary importance of their symbolic representatives. It behooves the elementary mathematical teacher to be particularly heedful of this principle which has taken pedagogical shape in the familiar phrases: "The idea before its symbol," "The thing before the sign," etc. Not to heed it is to go back to the methods of the old commentators 1800 years ago when any jargon of words passed for attainment.

Part of the artificiality which runs through current arithmetical teaching is due to the artificial character of the subject-matter. Another part owes its origin to the lamentable fact that many, if not most, of the grade teachers of arithmetic have never studied mathematics beyond the immediate needs of their positions, and are therefore not clear as to the ultimate purpose of their work. A third part is due to the fact that many forget, or do not believe, that the pupil may be familiarized with the fundamental ideas of arithmetic by actually working with number in a rational way, without any attempt to force arithmetical ideas and processes into the pupil's consciousness by requiring him to commit definitions whose significance and beauty depend upon the extent of their reach beyond his experience.

It would seem, therefore, that the use of such unmathematical terms as "and" for "plus" and "less" for "minus" while the pupil is engaged in acquiring the new idea of the nature of the processes of addition and subtraction is good pedagogy, if not good science. This does not mean that the terms "plus" and "minus" must not be taught at all in the grades, but rather that the ideas for which they stand should be first acquired with as little loss of energy as possible by the use of words which can have a meaning only after the acquisition of these ideas. To add and subtract rationally and intelligibly first and for some time (until the meaning of the operations is clear), and then to name the new acts with distinctive terms, which do not have a penumbra of popular and irrelevant suggestions clinging to them, seems also to be the *scientific* as well as the *pedagogical* order of procedure. This principle is of far-reaching significance in the teaching of arithmetic.

Let it be borne in mind that until the nature of number and of numerical operations has become familiar and facile to the mind, it is useless to call upon the learner to perform a mental act which involves the conscious recognition of these abstract ideas. The learning of a definition is such an act. After the pupil has worked with both concrete and abstract numbers until the operations have become in a degree automatic, he will have sufficient mental energy left from the simple doing to perform the mental act of abstraction with vigor and clearness. Until this state is reached it is useless, aye, positively harmful, to talk to the pupil of number as an abstraction, of the ratio definition of number, and of various other important attributes of abstract number which lie so deep down in the essence of number that even the philosophers wrangle over them.

But an idea of number must sometime be formed by the pupil. If his training has been of the right sort, the pupil will at no late period in his mathematical study—soon enough indeed—come to feel instinctively, to *sense*, the real essence of number as a mental product. Working for a while with numbered things before his senses, then with numbered things before his memory, he will gradually learn, from the act of abstracting, by which he sets aside from thought the qualitative attributes of things which constitute their individuality, and from the exercise of the generalizing faculty, by which he gathers them together under a quantitative aspect, how to withdraw his attention more and more from the concrete qualities of things and still to retain a vigorous mental grasp upon them. If the teacher is careful to have the pupil always work rationally with numbered things, either physically or mentally present, he will find him more ready than he thinks to perform the mental act by which the individual, with its qualitative differences, is dropped from thought, or better, is submerged to an extent, and the general, with its quantitative likenesses, is elevated into prominence. This is merely a roundabout way of saying that the abstract idea of number must be reached as a generalization from the concrete numbered thing. It would therefore be equally unpsychological to use no concrete things at all in number teaching, and never to use anything else. Number is in its essence abstract, but let us not forget that the road to its hidden mysteries lies through the concrete.

While much of the number work of the elementary grades is open to the criticism of being fragmentary, even to the verge of frivolousness, there is danger of going too far to the other extreme. The motive for the doing of the number work must be present to the child's mind with sufficient clearness to make a decided appeal to him. To draw his number work from a problem so complicated in its details, such as the determination of the cost of the materials and erection of an elaborate structure, requires too great continuity of thought, depends upon the appreciation of the value of a motive too ultimate to make a strong appeal to him, for the pupil to profit by it.

Such problems, at too early a stage, are practically without a motive for the child, though they may appeal strongly to the adult.

Topics for the preparation of papers and discussions:

1. Discuss the number work done in connection with the topographic map of the park with reference to its place and value in the grades.
2. What is meant to-day by the study of arithmetic for its utility? How does this differ from what was meant formerly by utility as an end of number study?
3. What should be allowed to become mechanical with the pupil in arithmetic, and what should not?
4. Is it ever wise to attempt to secure mechanical skill in the performance of operations which the attainment or maturity of the pupil make it impossible for him to understand at the time?
5. Should the maxim, "Tell the child as little as possible, and allow him to discover for himself as much as possible," be understood to mean, "Tell the child nothing at all"? Substantiate your answer.
6. What is meant by inductive methods of teaching? By deductive? Give an example of each. When should arithmetical study be made largely inductive, and when should deduction be begun?

Physical Training

Carl J. Kroh Caroline Crawford

The living worker, apt and of insight, is not slow to appreciate the fact that methods of study based upon mere statement of fact are not productive of lasting results. He enhances his study by a wise direction of effort toward the establishment of fundamental facts. Information and experience are gathered in the practical